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HOT RUNNER NOZZLE
[Heisskanaldüse]

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Hot Runner Nozzle

The present invention relates to a hot runner nozzle pursuant to the preamble to claim 1.

Sprue nozzles that are arranged at the end of a hot runner nozzle and can be electrically heated, as described in DE-OS 16 29 704, have a tip that leads into the molding cavity. Arrangements having multiple radial channels in tongue-shaped nozzle tips for the purpose of pouring a melt through multiple injection ports simultaneously into a hollow molding cavity or into a number of molding cavities are found in DE-OS 34 17 220. Both designs are disadvantageous due to severe heat losses, which result from the placement of the hot nozzle(s) on or in the cooled mold plate.

Attempts have been made to eliminate the material pass-through at the nozzle caused by poorly thermally conductive or insulating seals, for example according to DE-OS 32 08 339. However in this case in order to permit lateral injection molding a wall is always necessary, onto which material solidifies at the end of a production cycle. As a result of this, at the start of the subsequent cycle a cold grafting must be pressed into the article to be manufactured, which not only necessarily increases the thickness of the article, but also leads to surface defects and a lack of strength.

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[1] Numbers in the margin indicate pagination in the foreign text.

Similar product flaws result from the use of shut-off nozzles as are known, for example, from DE-OS 31 24 958. In order to exclude the possibility of a solidification of the melt in the injection port, a portion of the end of the nozzle seal extends into the mold plate; the injection port is opened and closed by means of a valve needle. A device comprising a nozzle element that has at least three nozzle heads, each with a stopper needle, is described in DE-OS 37 33 363. The nozzle heads are loaded with plastic molding compound from a main channel; the stopper needles, which are housed in an inner core, are actuated via a common lifting device.

With such necessarily narrow arrangements, high flow resistance levels occur. The friction of the compound against the needle generates a great deal of heat, which in turn can cause thermal damage to the product and can lead to the formation of terrible odors. Especially with articles having wider gate points, disturbing surface deviations can occur. Namely, if the ejecting end surface of the valve needle reaches a greater diameter, then an inwardly or outwardly curved, but in any case not smooth, surface is created on the product, in some cases even with problematic flash.

With injection molding, in general narrow temperature ranges are necessary, as otherwise a thread formation or a freezing of the sprue will occur. If the temperature of the injection compound is too low, the sprue will be cold for too long. Problems then arise with stamping the product with an expiration date, for example on the

bottom of a cup, or uneven areas are created, so that, for example, a cup will not stand up easily. The sprue area on the product is extremely susceptible to breakage, and frequently is the basis for a product recall.

Therefore there is a need for a solution to these problems. A key objective of the invention is to overcome the disadvantages of the state of the prior art, and to further improve upon a device of the type described above such that, using simple means, a multiple-gate injection molding process can be cost-effectively implemented, regardless of the type of hot runner system that will later be used, even with larger sprue ports.

The main characterizing features of the invention are the object of claim 1 and claim 11. Embodiments are disclosed in claims 2 through 10 and 12 through 16.

Due to the measure of providing the nozzle element with highly heat-conductive guide tips on or near it lower end, which can be shifted and secured relative to the molding cavity, the wall thicknesses toward the cavity can be made substantially thicker and more stable, even more than has thus far been possible with lateral injection molding. In the guide tips, passive, expandable structural elements bring heat beyond the edge area that is filled with melt, directly up to the injection-molded article. The guide tips namely feed thermal energy up to the injection point, which contributes significantly to the fluidity of the material, and above all forms the

sprue area more evenly. Thus with an extraordinarily low design and construction expenditure, considerable product improvement is achieved.

For manufacturing as well as for maintenance and upkeep it is highly advantageous if, according to claim 2, the guide tips, which are arranged on or in a highly thermally conductive mount, can be removed for assembly or disassembly or such that they can be retracted inside the mount. The high thermal conductivity of the mount ensures maximum heat transmission from the hot runner nozzle into the molding cavity, and thus also contributes to the rapidity and the quality of the manufacturing process, which is highly energy-efficient.

In design terms it is favorable if the mount according to claim 3 can be installed in or removed from the molding cavity plate via a boring, especially both from one direction and from the other direction (above and below), as desired. This is supported by the design of claim 4, wherein the mount concentrically encompasses a cylindrical bushing for the essentially rotationally symmetrical nozzle element.

According to claim 5, the mount can be attached to the nozzle element or to the molding cavity plate before the nozzle element is installed, by means of a spacer ring or cage that is mounted on a support and has poorly heat-conductive lands, so that an effective insulation to the housing is created and the heat losses are /4

correspondingly low. This design permits the nozzle element to be installed at a later time in the mount, which is first fastened on the machine tool. This is highly advantageous in terms of maintenance and upkeep; any repairs that may have to be made to the active elements, for example the heating element of the hot runner nozzle, thus require a significantly reduced amount of work.

The mount according to claims 6 and 7 is assembly and maintenance friendly, wherein the mount [verb omitted - translator] with a clamp ring for the guide tips that can be set and removed, and which can be fastened using at least one pressing screw. The installation is accomplished rapidly and precisely, particularly since suitable latching means can be provided on the clamp ring and/or on the guide tips.

Hot runner nozzles, the guide tips of which have a cylindrical form with a conical end, and which are laterally offset from the cylindrical bushing of the nozzle element, are already available. However such guide tips as of yet cannot be shifted longitudinally, i.e. crosswise to the axis of the nozzle element. In contrast, claim 8 provides that the shiftable and securable guide tips can be positioned perpendicular or tilted relative to the axis of the nozzle element. In addition, according to claim 9, centering elements, for example a recess into which an allocated collar extends, can be provided on the guide tips, on the mount, and/or on the extension piece.

All of these measures make it possible to perform any type of injection molding in a simple manner. The prerequisites for a multiple lateral injection molding process can be created in the injection molding machine tool, independent of a hot runner system to be installed later. Furthermore, an exchange of the actual hot runner nozzle is also possible, without requiring that the mount with the guide tips be removed from the machine tool beforehand. The fact that the seal is created by the plastic that has solidified on the cold walls further contributes to the rapid injection sequence and a defect-free quality.

In one important embodiment - for which independent protection is claimed - the invention provides according to claim 10 that a stopper needle is provided that can be moved lengthwise and has an end that is designed as a base and is cooled. In particular, according to claim 11, a cooling medium is fed to the base inside the stopper needle, preferably via a dual channel or a dual tube with an intake and a return, which according to claim 12 can be arranged, well-insulated, within a metallic jacket tube. These measures are thermodynamically advantageous, since the supply of the cooling medium on the inside does not cool the walls of the stamp; the plastic that flows past the outside is thus cooled not here, but first in the area of the colder base. This is especially important at the end of the process cycle, in order to improve the solidification of the injected article in the sprue as well.

One further improvement consists, according to claim 13, in that the stopper needle has or forms a core that can be moved lengthwise in its channel, and which in its retracted position opens up an annular gap, which can be closed by pushing the core forward. In this the core, according to claim 14, can have a cone at its end, the taper angle of which determines the cross section of the annular gap.

The coolable core, which has a diameter of, for example 10 to 20 mm, serves in this case as an adjustable stopper system. Once the compound has been injected into the hollow molding cavity with the core retracted, the latter is pushed back forward, so that the annular gap is closed and the area of the article near the sprue is pressed flat. Thus no sprue is visible; the compressing of the molding compound during the pressing process results in a smooth, low-stress surface area with good tenacity. The flow cross-section can be easily adjusted to the requirements of the raw material via the cone angle. If the stopper needle or the core has a flat stamp surface that ends flush with the end of the nozzle tip, in accordance with claim 15, essentially even sprue areas are obtained, which are free from flash and doming to the greatest possible extent.

For assembly and maintenance it is favorable if, in accordance with claim 16, the guide tips that rest in the mount can be secured in position by inserting the nozzle element, especially by engagement of the extension piece with a rear face of the guide tips.

Further characterizing features, details and advantages of the invention are disclosed in the wording of the claims and in the following description of exemplary embodiments with reference to the drawings. These show:

Fig. 1 a partial axial section view of a hot runner nozzle installed in a molding cavity plate,

Fig. 2 a view from above, partially in section, along the line II-II from Fig. 1, of a nozzle element rotated 90° relative to Fig. 1,

Fig. 3 a schematic axial sectional view of the end of a stopper needle and

Fig. 4 an enlarged sectional view corresponding to the circle IV in Fig. 3, but in a modified embodiment.

The embodiment of a hot runner nozzle pursuant to the invention shown in Fig. 1 and 2 is generally indicated by the number 10. It comprises an attachment head 14, which is inserted into a boring 17 in a molding cavity plate 18 and comes to rest against the latter with a shoulder 16, and a nozzle element 26 that is held in a bushing 20 and is essentially rotationally symmetrical to an axis 12. A main central channel 22 extends through the nozzle element 26 up to the lower end /5
of an extension piece 27.

A mount 30 encompasses the extension piece 27 concentrically. It is fastened to a support 32 by means of a poorly thermally conductive spacer ring or cage 34, which is equipped with lands 36 arranged spaced around its circumference.

In the mount 30, guide tips 28 are held in place by means of a clamp ring 38, which can be fastened to the mount 30, for example by means of at least one pressing screw 48, thus clamping the guide tips 28 in their inserted radial position. To support the centering, a recess 40 in the mount elements 30, 38 can act in conjunction with a collar 42 on the guide tips 28, as a mechanical stop.

The conical ends of the guide tips 28, the main portion of which is cylindrical in form, lead into recesses in a molding cavity insert 46, which are designed as dome-shaped inlet cones 44 with an opening angle that is significantly larger than that of the guide tips 28. The latter extend right up to the sprue end of the inlet cone 44, which is connected to the molding cavity F. The boring 17 in the molding cavity plate 18 can be closed off at the bottom by a base 19. The material to be processed flows in the direction of the arrow M out of the main channel 22; the base 19 steers the material to the inlet cones 44, where the guide tips 28 further heat it. In this manner the highly fluid material passes through an annular gap 68 into the molding cavity F, which contains a suitable mold core K.

It is also possible and provided by the invention that in the extension piece 27 of the nozzle element 26 side channels 24 branch off of the main channel 22, which in Fig. 1 are indicated by a dotted line and extend up to the ends of the guide tips 28. In such cases the material to be processed flows in the injection molding process at

least also through the side channels 24 into the inlet cone 44 and thereby into the molding cavity F.

Fig. 3 and 4 illustrate sections of a stopper needle 50, which can be moved lengthwise, for example in the side channel 24. It forms a core 62, the lower end of which ends with a cone 66 with a stamp surface 64. When it is retracted, material to be processed is able to pass through the annular gap 68 to the molding cavity.

For cooling, the stopper needle 50 is equipped with an inner dual channel 52, which according to Fig. 3 has a dividing wall 55 within a jacket tube 58, but also - as shown in Fig. 4 - can be designed as a dual tube with parallel borings 54, 56 or as a hairpin tube. In any case the tube 52 contains an intake 54 and a return 56 for a cooling agent, preferably water. The outer, highly thermally conductive jacket tube 58 is insulated against the inner dual channel or tube 52 by an air space 60.

It is obvious that the taper angle of the cone 66 determines the allowable cross-section for the annular gap 68. The cone 66 may also be curved. What is important is that the stamp surface 64 be cooled in order for the sprue to be molded on the product P in the best possible manner, namely to press it flat.

The invention is not limited to the embodiments presented here. What is important is that the coolable inner core 62 - which can have a relatively large diameter of, for example, 10 to 20 mm - should serve as a stopper needle. The relatively large base area of the

stamp is brought to lower temperatures by the cooling system arranged and insulated inside it, so that the sprue area can be qualitatively pressed free from defects.

The arrangement is suitable for use both in simple injection molding processes and for multiple-gate injection molding processes, especially for articles that are thicker around the walls of the molding cavity. Because the guide tips 28 can have a selectable tilt to the axis 12, any type of injection molding is possible.

All of the characterizing features and advantages, including the structural details, spatial arrangements and process steps, that proceed from the claims, the description and the drawings can be considered essential to the invention both alone and in the broadest range of combinations.

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Legend G 553

F	Molding cavity
K	Molding core
M	Material flow
P	Product

10	Hot runner nozzle	40	Recess
12	Axis	42	Collar

14	Attachment head	44	Inlet cone
16	Shoulder	46	Molding cavity insert
17	Boring	48	Pressing screw
18	Molding cavity plate	50	Stopper needle
19	Base	51	Base
20	Bushing	52	Dual channel/tube
22	Main channel	54	Intake
24	Side channels	55	Dividing wall
26	Nozzle element	56	Return
27	Extension piece	58	Jacket tube
28	Guide tips	60	Air space
30	Mount	62	Core
32	Support	64	Stamp surface
34	Spacer ring/cage	66	Cone
36	Lands	58	Annular gap
38	Clamp ring		

Patent Claims

1. Hot runner nozzle (10) for injection molding devices, with an attachment head (14) that can be fastened to a molding cavity plate (18) and on which a nozzle element (20) is arranged, inside which a heatable main channel (22) for the plastic

compound to be processed extends, which is equipped as needed with stopper needles (50) in the main channel and/or in side channels that lead to a molding cavity plate (18), **characterized in** that the nozzle element (26) has highly thermally conductive guide tips (28) on or near its lower end (27), which can be shifted and secured relative to the molding cavity (F).

2. Hot runner nozzle pursuant to claim 1, **characterized in** that the guide tips (28) are arranged on or in a highly thermally conductive mount (30) and for assembly or disassembly can be removed or retracted.

3. Hot runner nozzle pursuant to claim 1 or 2, **characterized in** that the mount (30) is designed to be installed in and removed from the molding cavity plate (18) from a boring (17), preferably in both directions of the boring axis.

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4. Hot runner nozzle pursuant to claim 2 or 3, with a nozzle element (26) that is essentially rotationally symmetrical relative to an axis (12), **characterized in** that the mount (30) concentrically encompasses a cylindrical extension piece (27) of the nozzle element (26).

5. Hot runner nozzle pursuant to one of claims 1 through 4, **characterized in** that the mount (30) is or can be attached to the nozzle element (26) or to the molding cavity plate (18) prior to installation of the nozzle element, by means of a spacer ring or cage (34) that is fastened to a support (32) and is equipped with poorly thermally conductive lands (36).

6. Hot runner nozzle pursuant to one of claims 2 through 5, **characterized in** that the mount (30) is equipped with a clamp ring (38) for the guide tips (28) that can be secured and loosened.

7. Hot runner nozzle pursuant to claim 6, **characterized in** that the clamp ring (38) can be secured by means of at least one pressing screw (48).

8. Hot runner nozzle pursuant to one of claims 1 through 7, wherein the guide tips (28) have a cylindrical form with a conical end, and project radially or like spokes from the extension piece (27) of the nozzle element (26), **characterized in** that the guide tips (28) are arranged perpendicular to or tilted relative to the axis (12) of the nozzle element (26).

9. Hot runner nozzle pursuant to one of claims 4 through 8, **characterized in** that centering elements are provided on the guide tips (28), on the mount (30) and/or on the bushing (26), for example a recess (40), into which an allocated collar (42) extends.

10. Hot runner nozzle, especially pursuant to one of claims 1 through 9, **characterized in** that a stopper needle (50) that can be moved lengthwise and is namely stamp-shaped is provided, with a cooled end designed as a base (51).

11. Hot runner nozzle pursuant to claim 10 **characterized in** that a cooling agent is fed to the base (51) inside the stopper needle (50), preferably via a dual channel or a dual tube (52) with an intake and return flow (54 and 56, respectively).

12. Hot runner nozzle pursuant to claim 11, **characterized in** that the dual channel or the dual tube (52) is arranged inside a metallic jacket tube (58) especially with concentric insulation.

13. Hot runner nozzle pursuant to claim 11 or 12, **characterized in** that the stopper needle (50) has or forms a core (62) in its channel (22; 24) that can be moved longitudinally, and which in

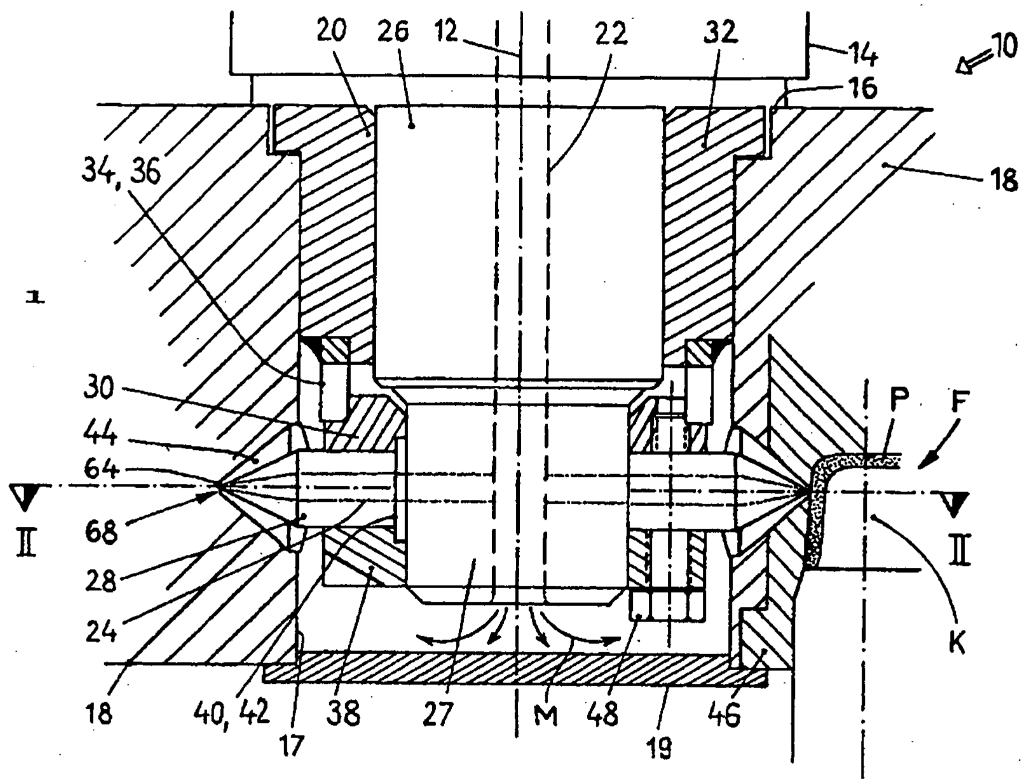
its retracted position opens up an injection-molding annular gap (68), which can be partially or completely closed by pushing the core (62) forward.

14. Hot runner nozzle pursuant to claim 13, **characterized in** that the core (62) has a cone (66) on its end, the taper angle of which determines the cross-section area of the annular gap (68).

15. Hot runner nozzle pursuant to one of claims 11 through 14, **characterized in** that the stopper needle (50) or the core (62) has a flat stamp surface (64) that ends flush with the end of the guide tip (28).

16. Hot runner nozzle pursuant to at least one of claims 1 through 15, **characterized in** that the guide tips (28) that rest in the mount (30, 38) can be secured in position by inserting the nozzle element (26), especially via an engagement of the extension piece (27) with a stop surface (42) on the backs of the guide tips.

Fig. 1



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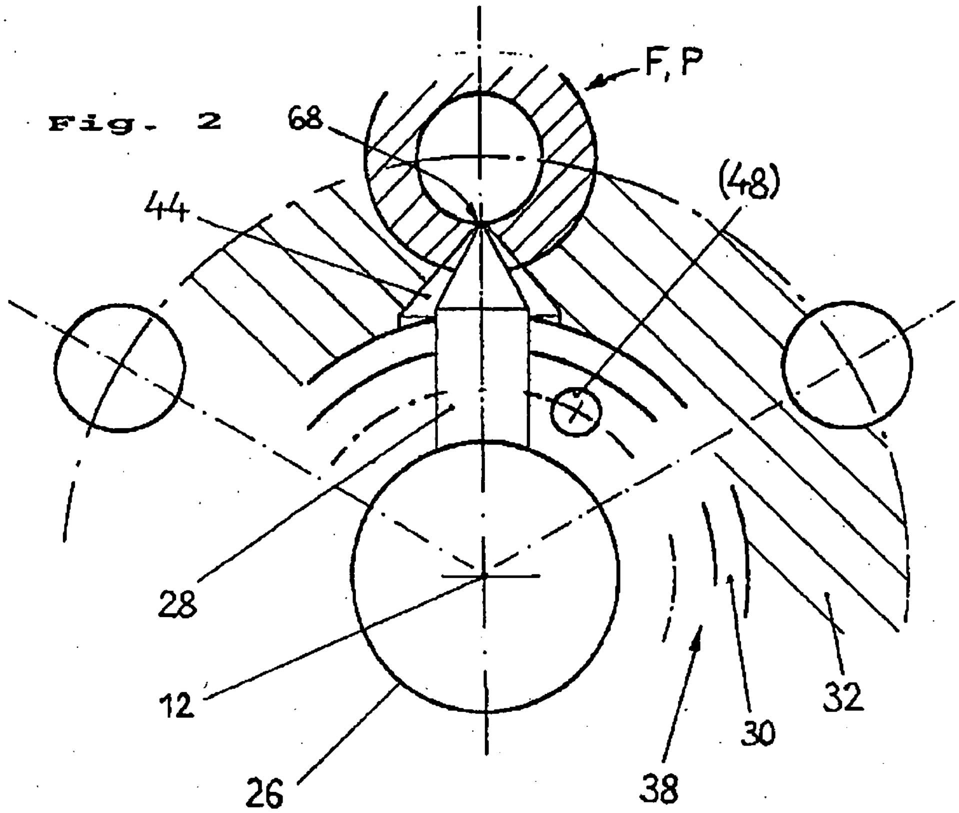

Fig. 2

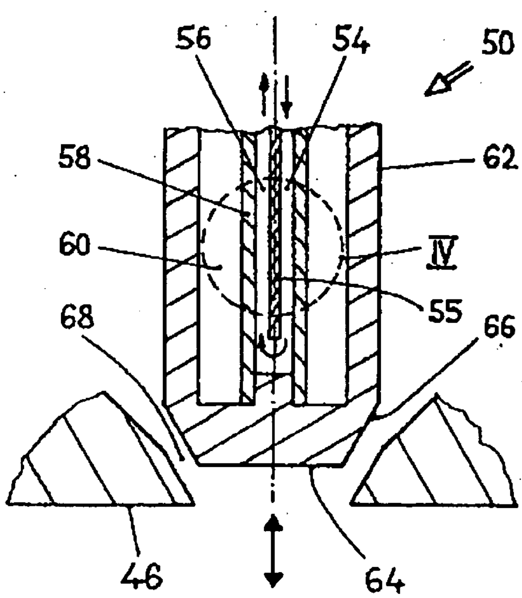

Fig. 3

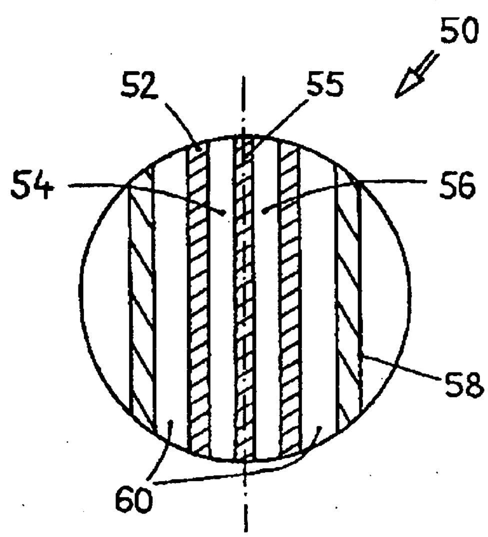

Fig. 4

EUROPEAN SEARCH REPORT

European Patent Office

Application Number EP 90 10 5053

RELEVANT DOCUMENTS			
Category	Characterization of document with indication, if necessary, of relevant sections	Relates to Claim	CLASSIFICATION OF APPLICATION (Int. Cl.^{5})
X	EP-A-0 186 413 (TANNER) * Entire Document* ---	1, 2, 8, 16	B 29 C 45/30 B 29 C 45/28
A	PLASTICS, Volume 70, No. 11, November 1980, pages 730-737, Munich, DE; P. UNGER; "Heisskanalsystem mit indirect beheiztem Wärmeleittorpedo" [Hot Runner System with Indirectly Heated Thermal-Conductivity Torpeo] * Figure 11 * ---	1	
A	US-A-4 304 544 (CRANDELL) * Column 5, line 57 - column 6, line 2; column 6, lines 22-33; Figures 29, 33 * ---	1, 10, 13-15	
A	FR-A-2 591 936 (ITT REISS INTERNATIONAL) * Patent claims 1,2 * ---	10	
A	PATENT ABSTRACTS OF JAPAN, Volume 10, No. 59 (M-459)[2116], 8 March 1986; & JP-A-60 206 613 (SHIGERU TSUTSUMI) 10-18-1985 -----	10, 11	SEARCHED FIELDS (Int. Cl.^{5})

			B 29 C
The above search report was performed for all patent claims			

Search Location	Date search was completed	Examiner
THE HAGUE	11-14-1990	BOLLEN J.A.G.

CATEGORY OF LISTED DOCUMENTS

X: of particular importance When viewed alone
Y: of particular importance in combination with another publication from the same category
A: Technical background
O: Non-written disclosure
P: Intermediate literature

T: Theories or principles upon which the invention is based
E: older patent document that was published on or after the application date
D: document referenced in the application
L: documents referenced for other Reasons

&: Member of same patent family, supporting document